ISSN (print) 0093-4666 © 2012. Mycotaxon, Ltd. ISSN (online) 2154-8889

MYCOTAXON

http://dx.doi.org/10.5248/120.437

Volume 120, pp. 437–441 *April–June 2012*

First record of the sequestrate fungus *Neosecotium macrosporum* (*Agaricales*, *Lepiotaceae*) from Mexico

Marcos Lizárraga[1], Martín Esqueda[2*], Mario Vargas-Luna[1] & Gabriel Moreno[3]

[1]*Dpto. de Ciencias Químico-Biológicas, Instituto de Ciencias Biomédicas, Universidad Autónoma de Ciudad Juárez, Anillo Envolvente Pronaf y Estocolmo s/n, Cd. Juárez, Chihuahua 32300, México*

[2]*Centro de Investigación en Alimentación y Desarrollo, A.C. Apartado Postal 1735, Hermosillo, Sonora 83000, México*

[3]*Dpto. de Biología Vegetal, Facultad de Biología, Universidad de Alcalá, Alcalá de Henares, Madrid 28871, Spain*

* Correspondence to: *esqueda@ciad.mx*

Abstract — *Neosecotium macrosporum,* previously known only from two USA records, is reported for the first time in Mexico. Observations of macro- and microscopic characters including for the holotype and the Chihuahua collection are presented. SEM photomicrographs illustrating spore ornamentation are included.

Key words — *Basidiomycota*, taxonomy, hypogeous fungi, secotiaceous fungi

Introduction

Sequestrate fungi are considered a polyphyletic group with no evolutionary relationships whose morphological similarity comes from the adaptation to extreme habitats and environmental conditions (Albee-Scott 2007). The approximately 1200 species are distributed among eleven orders representing the phyla *Zygomycota*, *Ascomycota,* and *Basidiomycota*. Distinguishing characteristics are a fleshy, cartilaginous or elastic fruiting body with a persistent peridium that encloses the spore producing tissue and thus prevents the easy release of the spores (Kendrick 1992). Most sequestrates are mycorrhizogenic and serve as a source of food for a number of mammals (Trappe & Claridge 2003).

There are few studies of this group in Mexico. The first sequestrate fungus recorded for Mexico was collected by Lumholtz (1902) and later designated as the holotype of *Melanogaster umbriniglebus* Trappe & Guzmán. Trappe &

Guzmán (1971) described three other new hypogeous species and 13 new records for Mexico, Cázares et al. (1992) cited 17 new records, and Cázares et al. (2008) described *M. minisporus* Cázares et al. as a new species and reported the first Mexican records of three species of *Hysterangium* Vittad.

Neosecotium Singer & A.H. Sm. is a genus characterized by a dry firm whitish stipe-columella that extends below a powdery gleba containing few fibulae and strongly verrucose spores (Miller & Miller 1988). In comparison, *Secotium* Kunze is characterized by the presence of a volva, a less powdery gleba with abundant fibulae, and smooth ellipsoid large spores. *Neosecotium* is represented by two species: *N. africanum* and *N. macrosporum*.

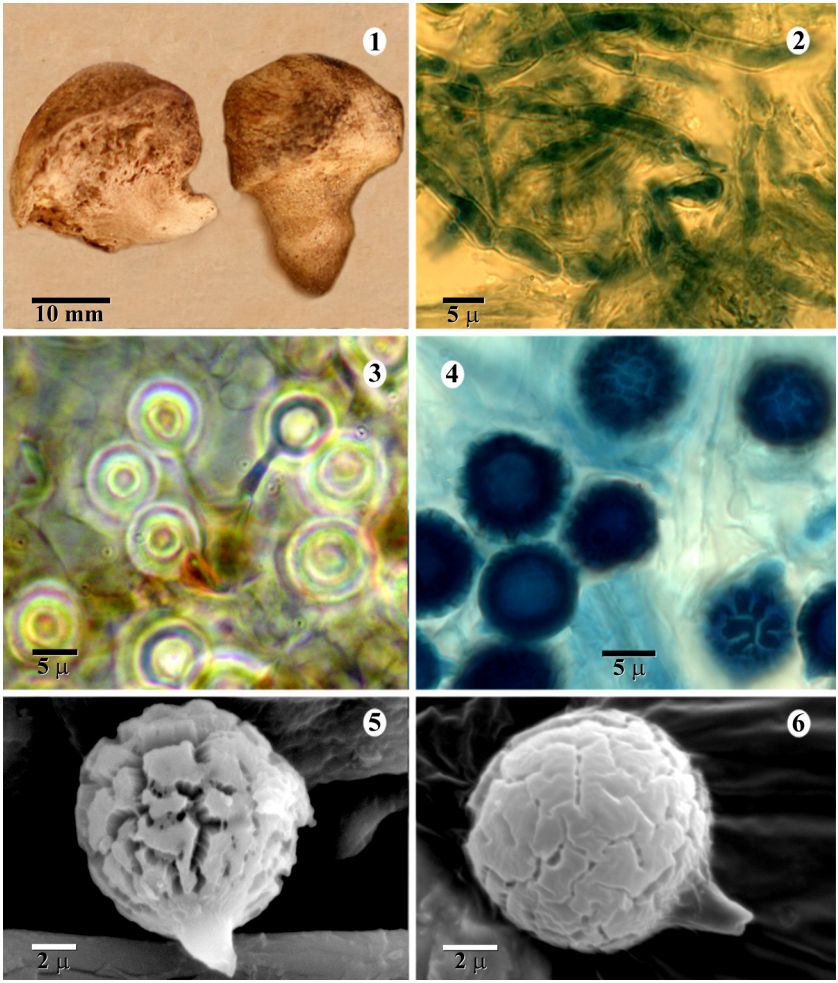
Materials & methods

The collections were studied according to the standard mycological techniques (Cifuentes et al. 1986, Moreno & Manjón 2010). The basidia, spores, peridial hyphae, gleba, and columella of specimens mounted in Hoyer's medium were measured using a Nikon Eclipse E200 contrast phase microscope, with some samples examined using a Zeiss DSM 950 scanning electron microscope after processing in a Polaron E-2000 for 1 min at 1.2 Kv and 20 mA, in an argon atmosphere to obtain a 500 Å thick deposition of gold. The specimens are deposited in the macromycetes collection of the Centro de Estudios Superiores de Estado de Sonora (CESUES) and the Universidad Autónoma de Ciudad Juárez (UACJ). The holotype was examined using the New York Botanical Garden's Virtual Herbarium (NY). Herbarium acronyms follow Thiers (2011).

Species studied

Neosecotium macrosporum (Lloyd) Singer & A.H. Sm.,
Madroño 15(5): 154 (1960). Figs 1–6
≡ *Secotium macrosporum* Lloyd Mycol. Writ. 1: 139. (1903).

Basidiomata subglobose to pyriform, measuring 11–15 × 7–10 mm. Peridium thick, 0.5–0.8 mm, membranaceous, yellowish brown when mature. Gleba composed of tightly packed lamellae, compact or forming pseudo-chambers, labyrinthiform in young specimens and powdery in old specimens; yellowish and dark brown when young and mature respectively. Stipe-columella percurrent, whitish, measuring 7–15 × 3–9 mm. Peridium of septate hyphae, branched, 2.5–4 µm in diam. Columella with hyphae similar to the peridium, septate, branched, 5–7.5 µm in diam. Basidia clavate, (25–)28–32(–35) × 3–5 µm at the base and 9–12 µm in the middle and upper part, yellowish brown in water; evanescent, leaving amorphous remains when mature. Basidiospores globose, subglobose to ovoid, pseudoamyloid, 10–13(–14) × 8–11 µm including ornamentation, which is strongly spiny with flat distal end; episporium 2–3 µm thick, covered by a membrane, which covers the depressions between the spines, giving a cracked appearance to the wall as observed under the SEM. Pedicel straight to slightly curved, 2–3 × 2–4 µm, narrowing toward the apex.



Figs 1–6: *Neosecotium macrosporum* (CESUES 5600).
1. Basidiome. 2. Peridium hyphae (LM). 3. Basidium (LM). 4. Spores (LM). 5–6. Spore (SEM).

Specimens examined: **MEXICO, Chihuahua**: **Municipality of Juárez**, 31°13′53.1″N 106°30′36.8″W, 1120 masl, in sandy soil near *Prosopis glandulosa* Torr., 24.VII.2009, M. Lizárraga, C. Salazar, D. López-Peña, D. Sáenz, A.H. Gutiérrez, E. Navarrete (CESUES 5550); 31°17′54.35″N 106°31′55.45″W, 1303 masl, 17.IX.2010, M. Lizárraga, M. Vargas, C. Salazar, D. Sáenz (UACJ 1560, CESUES 5600); 19.III.2011, M. Vargas, M. Lizárraga (UACJ 1683); 26.III.2011 (UACJ 1684).

Observations— The Mexican materials were compared with the type and other authentic collections of *Neosecotium macrosporum* in the Virtual Herbarium of the New York Botanical Garden (VHNYBG 2011), which allowed us to

confirm this determination. Although the holotype (NY 809166, from Texas) is in a state of deterioration, there are two collections of authentic material (NY 809164 and 809165, from North Dakota) identified as *N. macrosporum* by S.M. Zeller.

Basidiomes of the type and authentic material, in immature stages with chambers in an obscure lamellar orientation, wood brown to cinnamon color; stipe-columella percurrent, whitish, little projection of the stipe (2–3 mm); spores globose, subglobose to ovate, 13–18 or 14–18 × 12–15 µm, pseudoamyloid, with sterigmal appendage, exosporium smooth becoming cracked into an areolate pattern and the fissures produce a warty to echinulate effect; basidia clavate to subelliptic-pedicellate, 25–37 × 14–17 µm (Lloyd 1903; Singer & Smith 1960). The Mexican collections differ in the smaller spore size compared with those previously reported. This high variability appears to be inherent to the species and has also been reported for taxa close to *N. macrosporum*.

According to descriptions by Lloyd (1903) and Singer & Smith (1960), this species is easily recognized by its stipe-columella, which extends from the base of the gleba to the apex of the peridium, lamelliform gleba and strongly verrucose pigmented spores. Although unopened fruiting bodies of *Geastrum* spp. could be confused macroscopically with *Neosecotium*, the *Geastrum* is easily distinguished by violet spores, a two-layered peridium, and capillitium. Based on similar habitat and morphology, *Neosecotium* might also be confused with *Endoptychum* Czern., which can be distinguished by its smooth spores and somewhat larger fruiting bodies (Arora 1986).

Singer & Smith (1960) regarded *Neosecotium* as intermediate between the *Agaricaceae* and *Lycoperdaceae,* based on the variation in color and spore ornamentation in some genera in both families. Castellano et al. (2004) placed *Neosecotium* into *Lepiotaceae* based on recent molecular-supported classifications.

Neosecotium macrosporum has been recorded from two localities in the United States of America (Lloyd 1903, Singer & Smith 1960); the present study represents a new record for Mexico, and the third for the world.

Acknowledgments

The authors are grateful to CONABIO (project GT016) for funding this study. Our gratitude to Dr. H. Kreisel and Dr. R. Valenzuela for reviewing the manuscript and their useful comments. MVL thanks CONACYT (Mexico) for the award of a fellowship to carry out his M.Sc. studies and Aldo Gutierrez (CIAD) for preparing the plates and formatting the text. Bianca Delfosse translated the text from the original in Spanish.

Literature cited

Albee-Scott S. 2007. Does secotioid inertia drive the evolution of false-truffles? Mycological Research 111: 1030–1039. http://dx.doi.org/10.1016/j.mycres.2007.08.008

Arora D. 1986. Mushrooms demystified: a comprehensive guide to the fleshy mushrooms. Ten Speed Press, Berkeley. 959 p.

Castellano MA, Trappe JM, Luoma DL. 2004. Sequestrate fungi. 197–213, in: GM Mueller et al. (eds). Biodiversity of fungi: inventory and monitoring methods. Elsevier Academic Press, San Diego.

Cázares E, García J, Castillo J, Trappe JM. 1992. Hypogeous fungi from northern Mexico. Mycologia 84: 341–359. http://dx.doi.org/10.2307/3760186

Cázares E, Guevara G, García J, Trappe JM. 2008. *Melanogaster minisporus* sp. nov., a new sequestrate member of the *Boletales* from Mexico. Revista Mexicana de Micología 28: 67–69.

Cifuentes J, Villegas M, Pérez-Ramírez L, Sierra S. 1986. Hongos. 55–64, in: A Lot, F Chiang (eds). Manual de herbario. Consejo Nacional de la Flora de México, A.C., México.

Guevara G, Castellano MA, García J, Cázares E, Trappe JM. 2008. *Hysterangium* (*Hysterangiales*, *Hysterangiaceae*) from northern Mexico. Revista Mexicana de Micología 28: 95–100.

Kendrick B. 1992. The fifth kingdom. Focus Publishing, Newburyport. 406 p.

Lumholtz C. 1902. Unknown Mexico. Vol. 1. Charles Scribner's Sons, New York. 530 p.

Miller OK Jr, Miller HH. 1988. *Gasteromycetes*. Morphological and developmental features with keys to the orders, families, and genera. Mad River Press, Eureka. 157 p.

Moreno G, Manjón JL. 2010. Guía de hongos de la Península Ibérica. Ediciones Omega, Madrid. 1417 p.

Singer R, Smith AH. 1960. Studies on secotiaceous fungi VII. *Secotium* and *Neosecotium*. Madroño 15: 152–158.

Thiers B. 2011. (continuously updated). Index Herbariorum. Part I: the herbaria of the world. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/ih/

Trappe JM, Claridge AW. 2003. Australasian sequestrate (truffle-like) fungi. 15. New species from tree line in the Australian Alps. Australasian Mycologist 22: 27–38.

Trappe JM, Guzmán G. 1971. Notes on some hypogeous fungi from Mexico. Mycologia 63: 317–332. http://dx.doi.org/10.2307/3757764

VHNYBG. 2011. The C.V. Starr Virtual Herbarium. New York Botanical Garden, International Plant Science Center. http://sciweb.nybg.org/science2/vii2.asp [accessed September 2011].